Material scan of ladder tracker and Upsilon resolution

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matscan.C

The macro is at:

https://github.com/sPHENIX-Collaboration/tutorials/tree/master/materialscan

matscan.C
matscan_digest.pl
plot_matscan.C

See the README for instructions.

It is easy to use, thanks to Chris for the nice instructions!

The tracker setup

The ladder detector setup is created in:

/sphenix/user/frawley/QTG_simulations/macros/macros/g4simulations
G4_Svtx_maps_ladders+intt_ladders+tpc.C

where the number of maps layers can be set to 0-3, the number of intt layers can be set to 0-4.

The cylinder detector setup is created in the same directory by:
G4_Svtx_maps+intt+tpc.C

matscan.C setup

Parameters (angles in degrees):

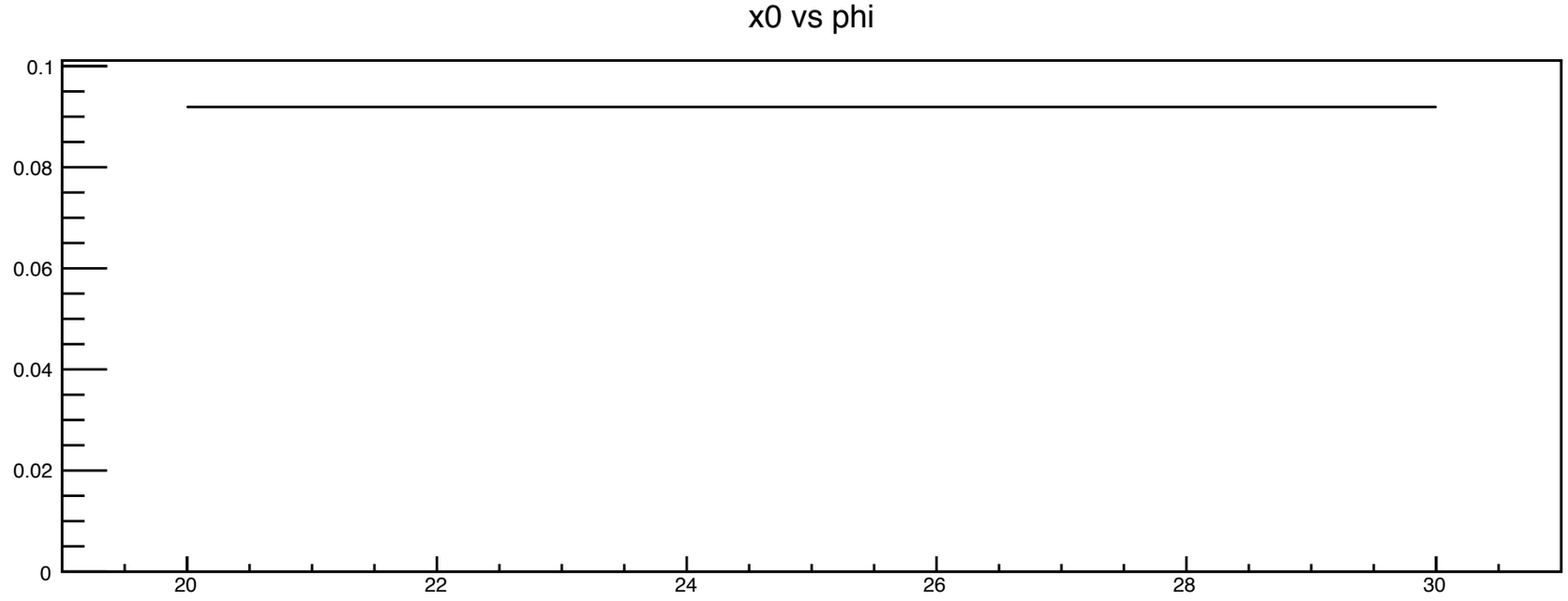
// the span is the delta phi/theta you want to cover, not the maximum angle

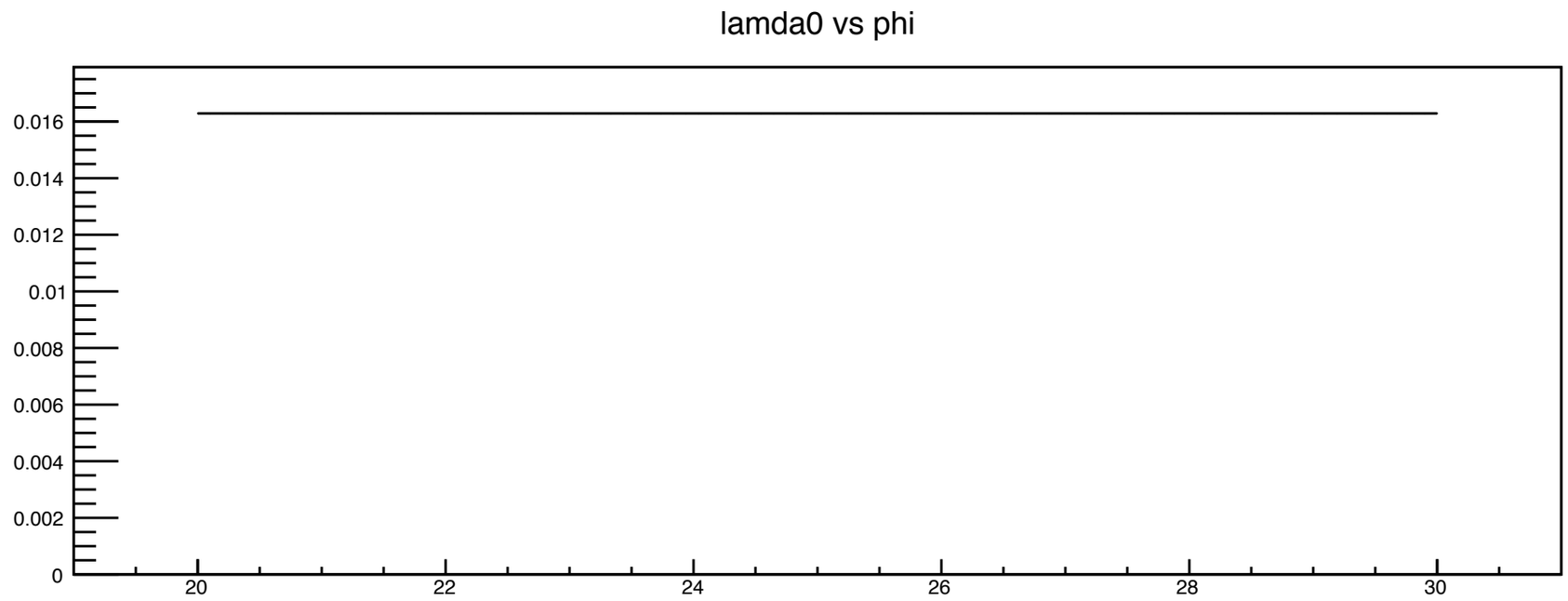
float phimin = 20.; // start at phi = 20 degrees
float phispan = 10.; // scan 10 degrees in phi
int phibins = 100;
float thetamin = 10.; // theta = 0 perp. to beam axis, start at theta = 10 deg
float thetaspan = 10; // scan 10 degrees in theta
int thetabins = 1;

Cylinder MAPS + cylinder INTT + TPC

Cylinder MAPS (3 layer) + cylinder INTT (4 layer) + TPC:

Total thickness
= 9.1%

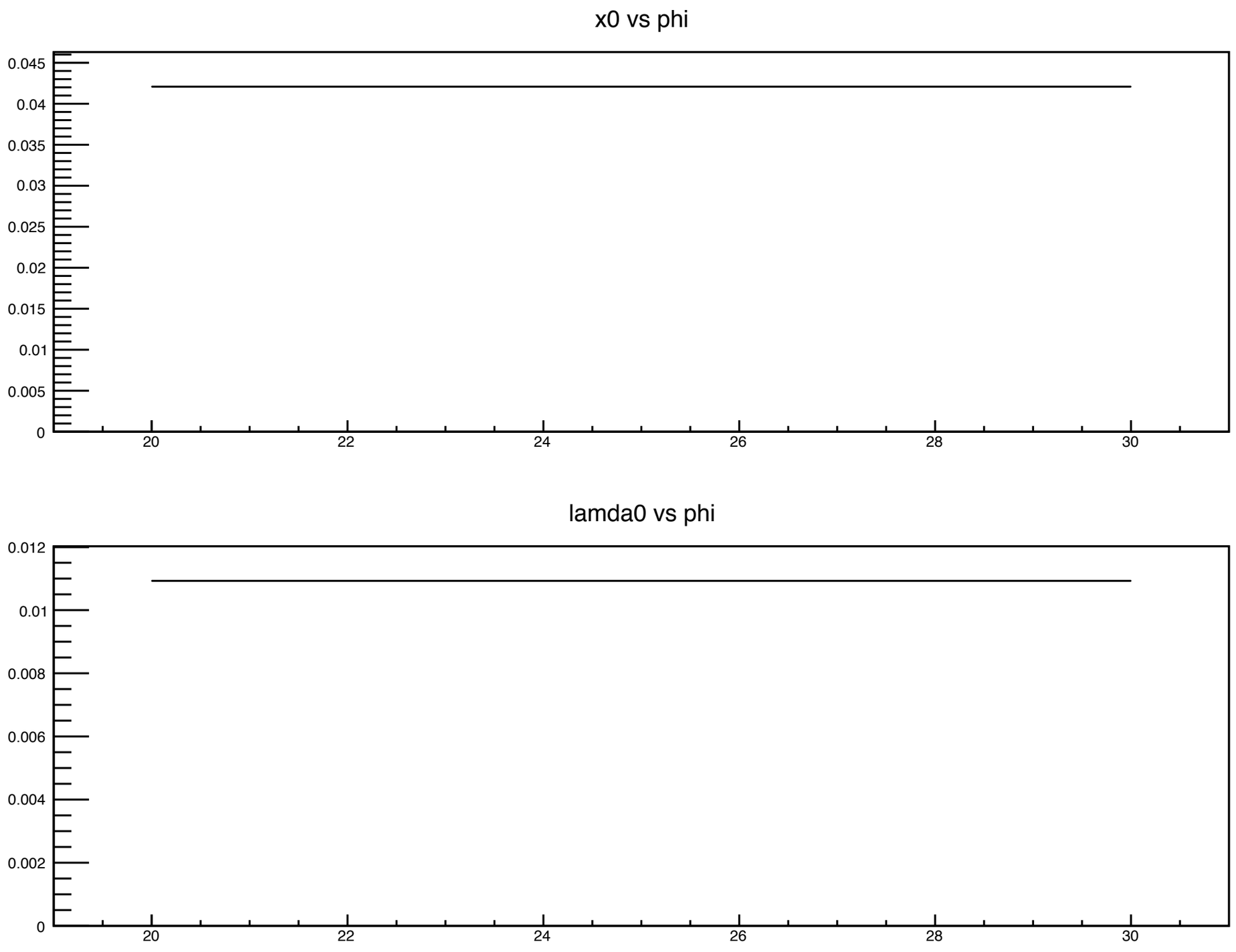




TPC

TPC only:

Total thickness = 4.4%

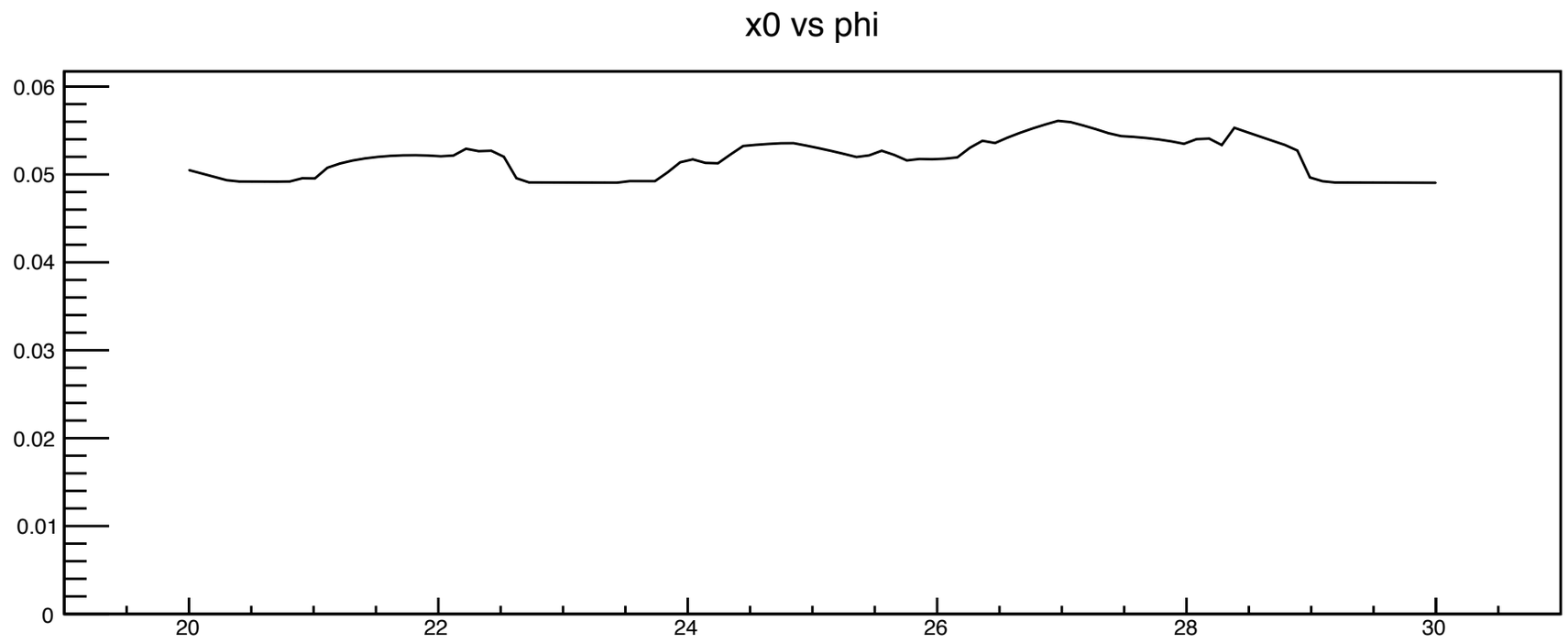


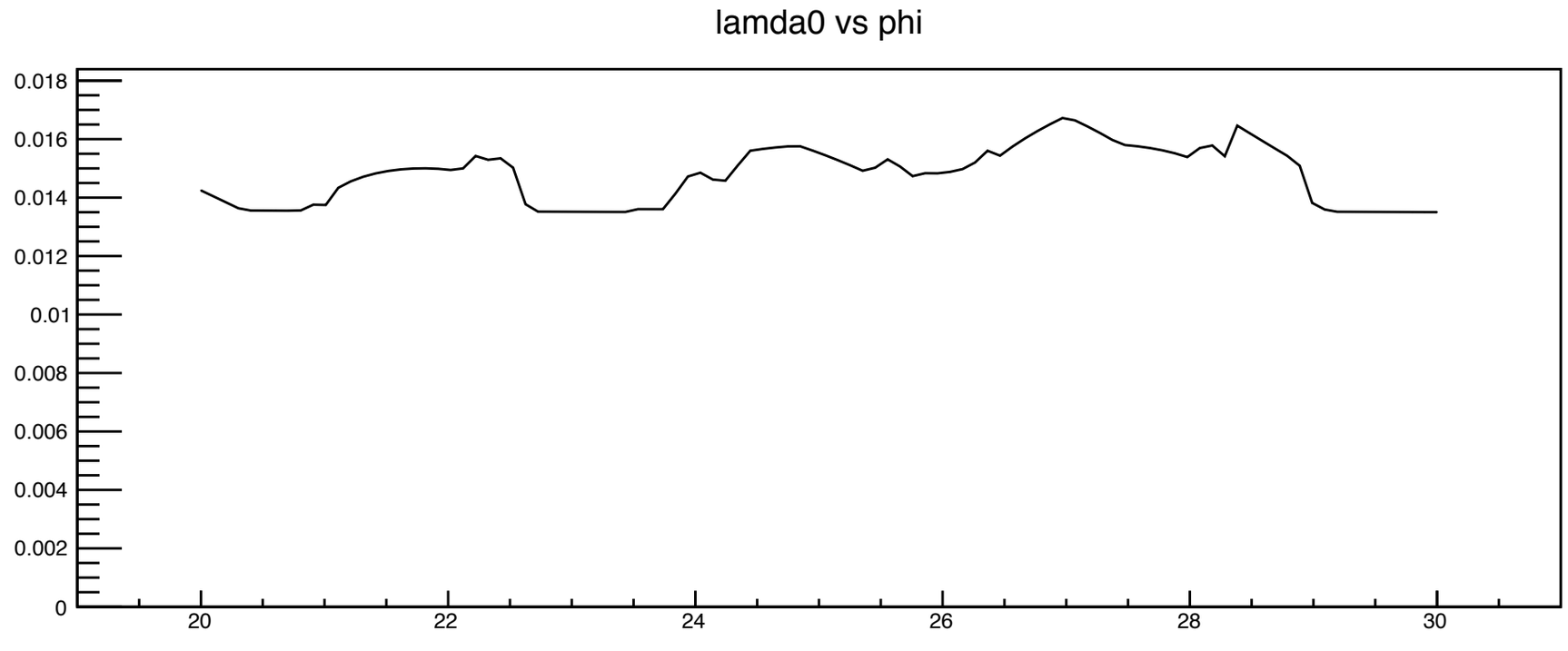
Ladder MAPS

Ladder MAPS (3 layer) + TPC:

Total thickness
= 5.4%

ladder maps
adds 1%





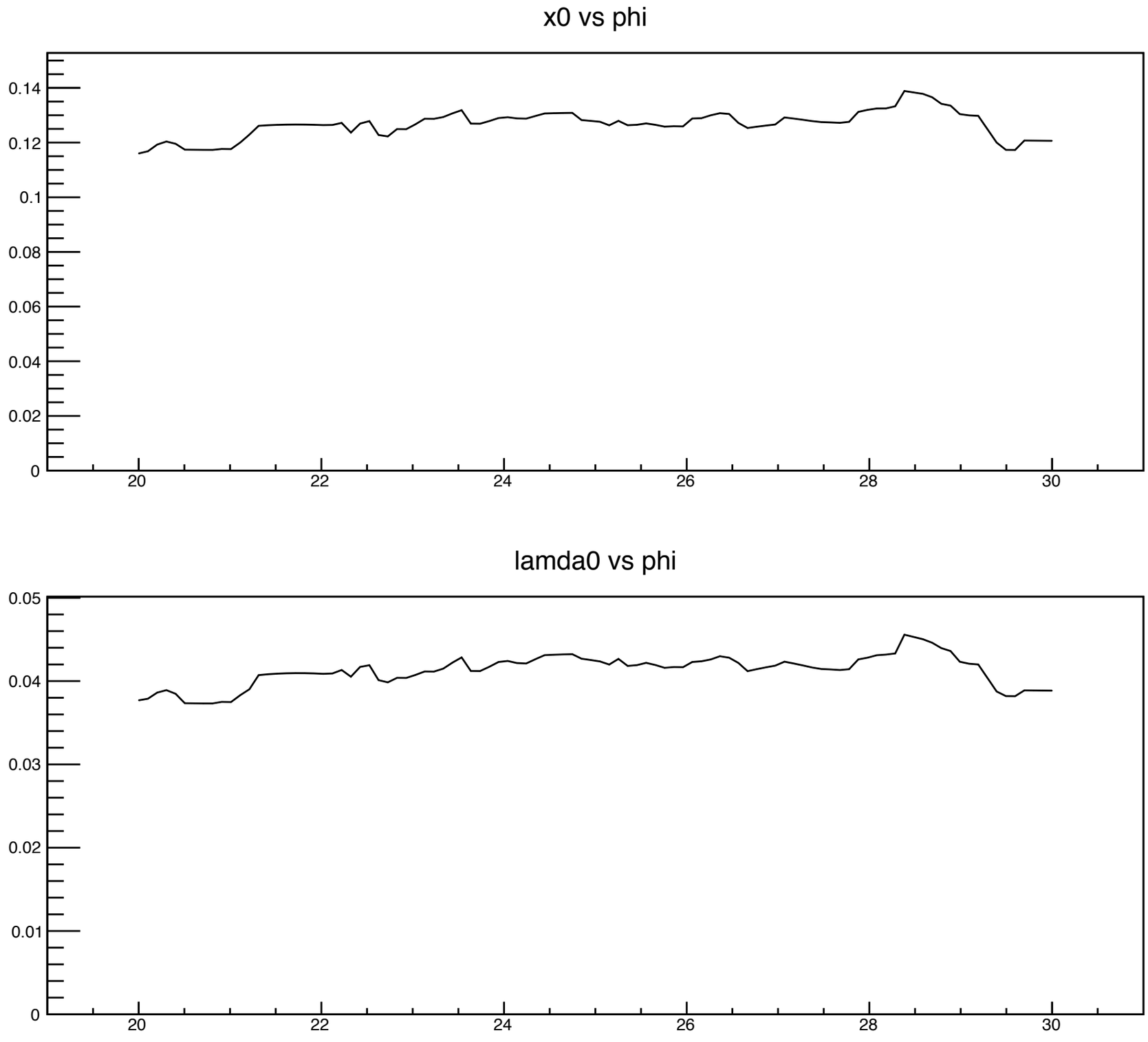
Ladder MAPS + ladder INTT + TPC

Ladder MAPS (3 layer) + ladder INTT (4 layer) + TPC:

Total thickness
= 12.75%

Ladder INTT
adds 7.4%

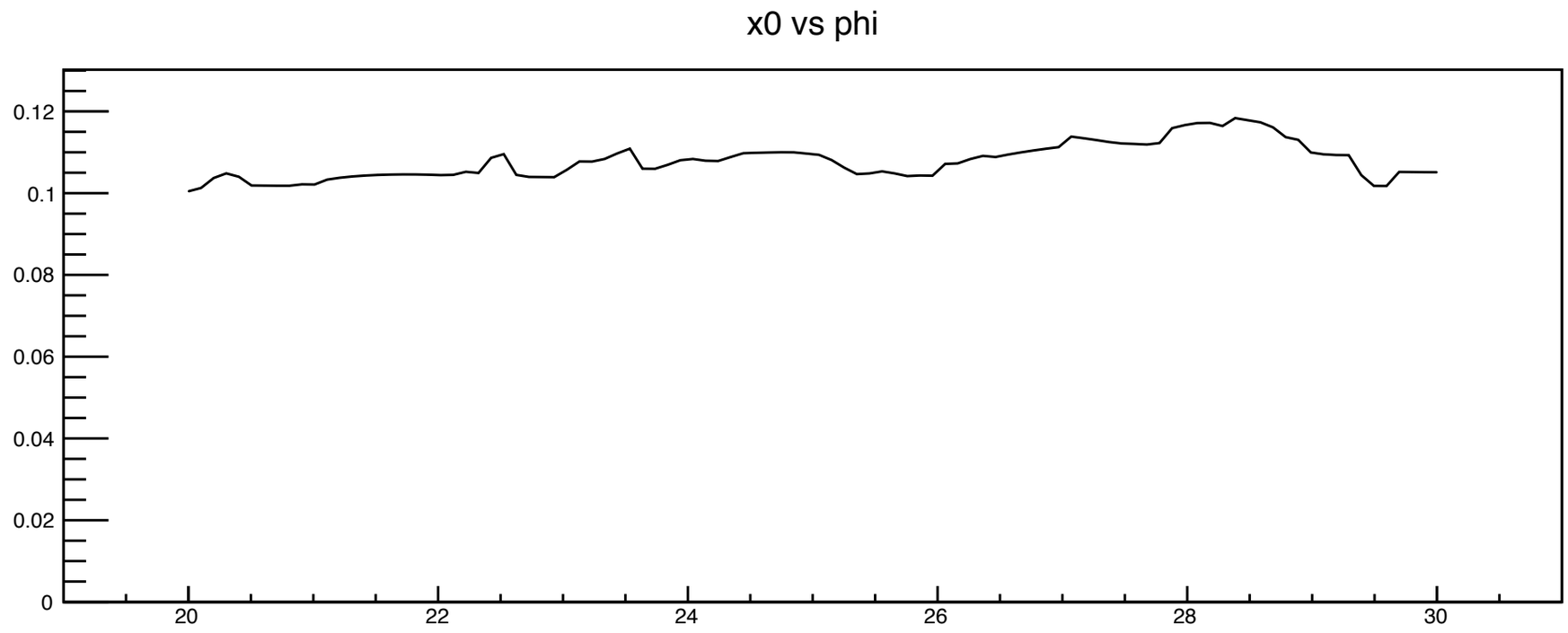
1.85% per layer

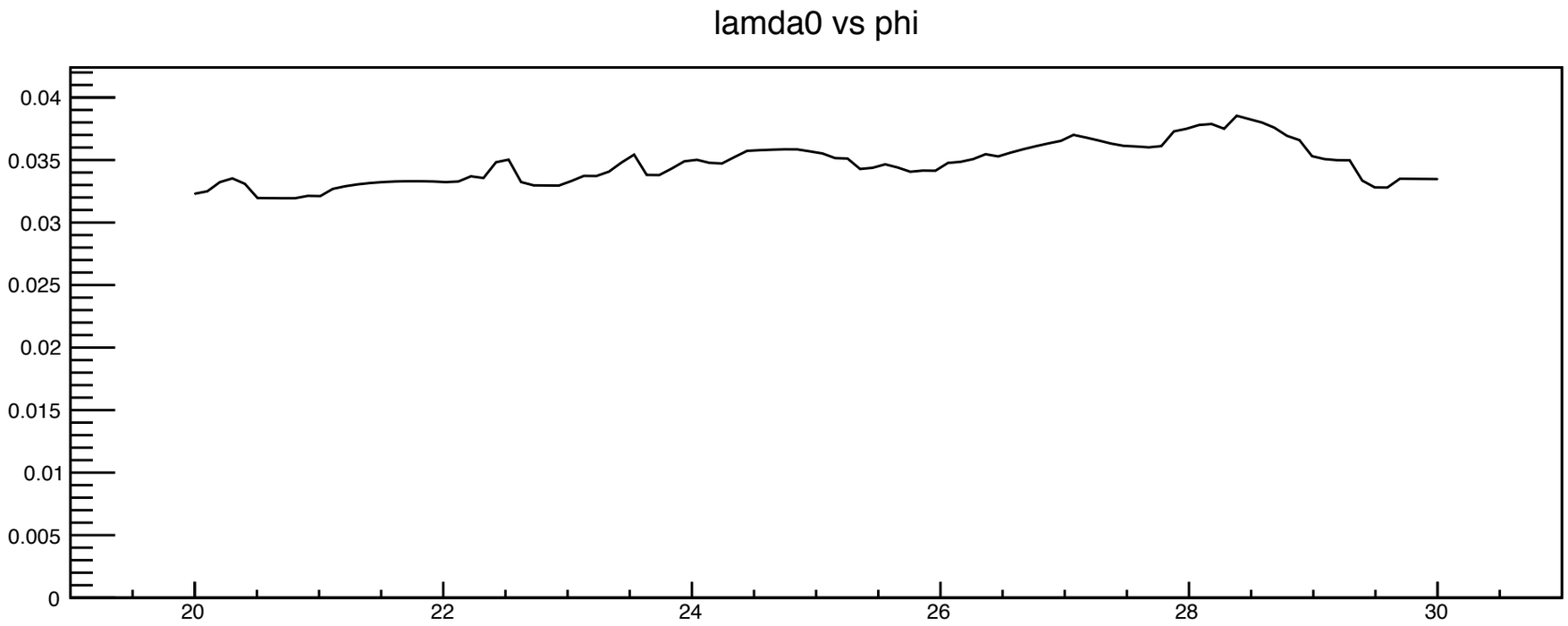


Reduce INTT to 3 layers

Ladder MAPS (3 layer) + INTT (3 layer) + TPC:

Total thickness
= 10.9%

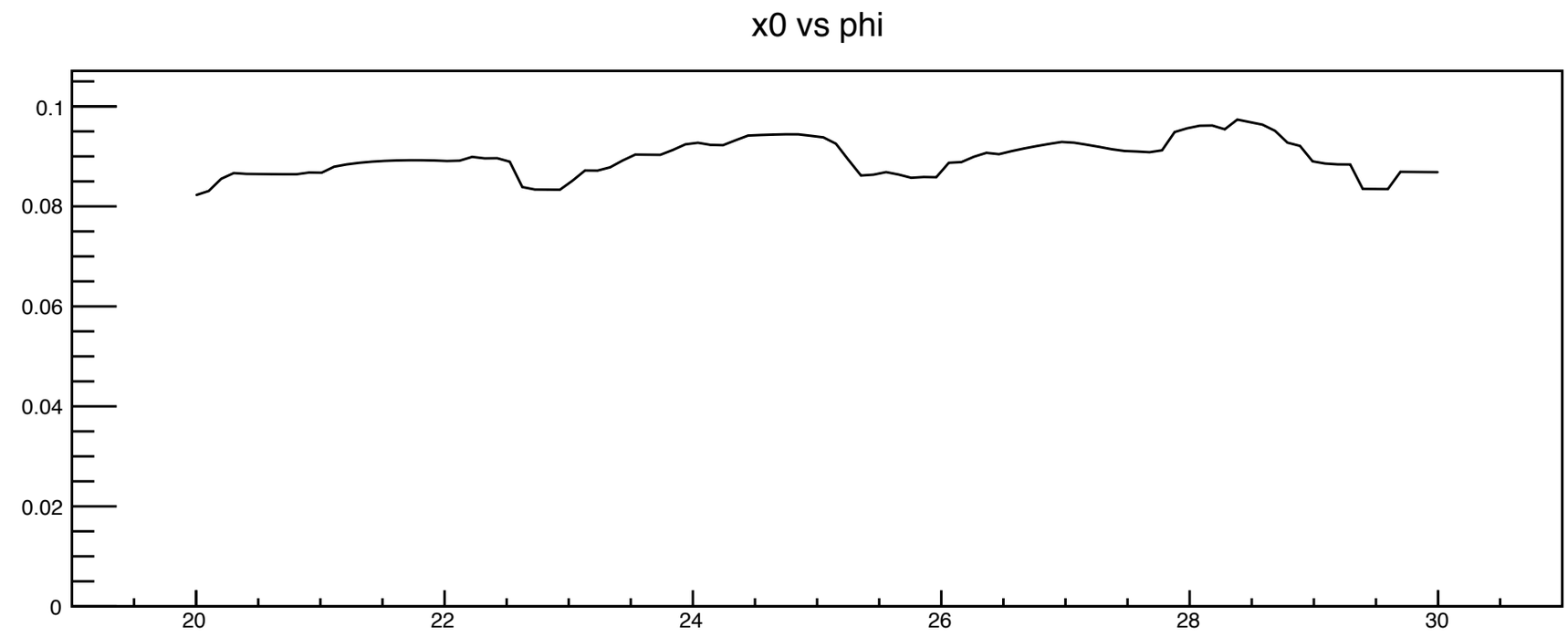


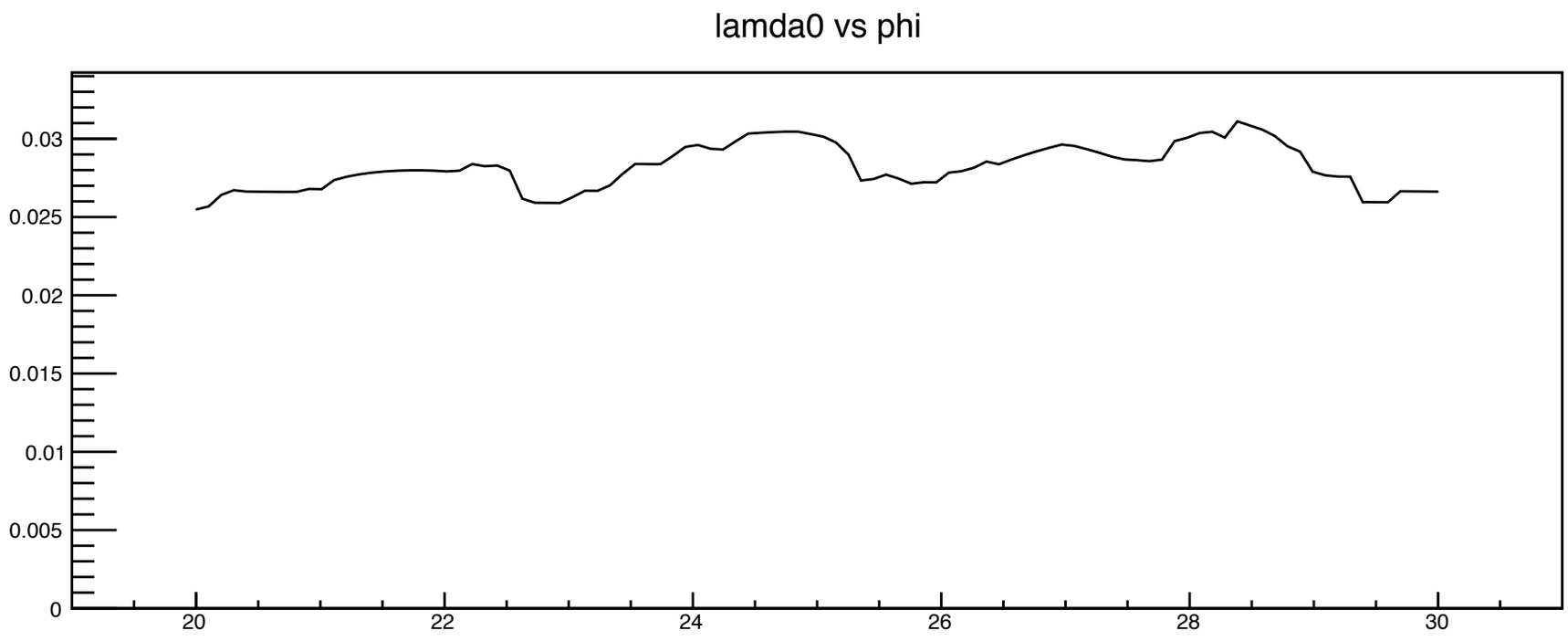


Reduce INTT to 2 layers

Ladder MAPS (3 layer) + INTT (2 layer) + TPC:

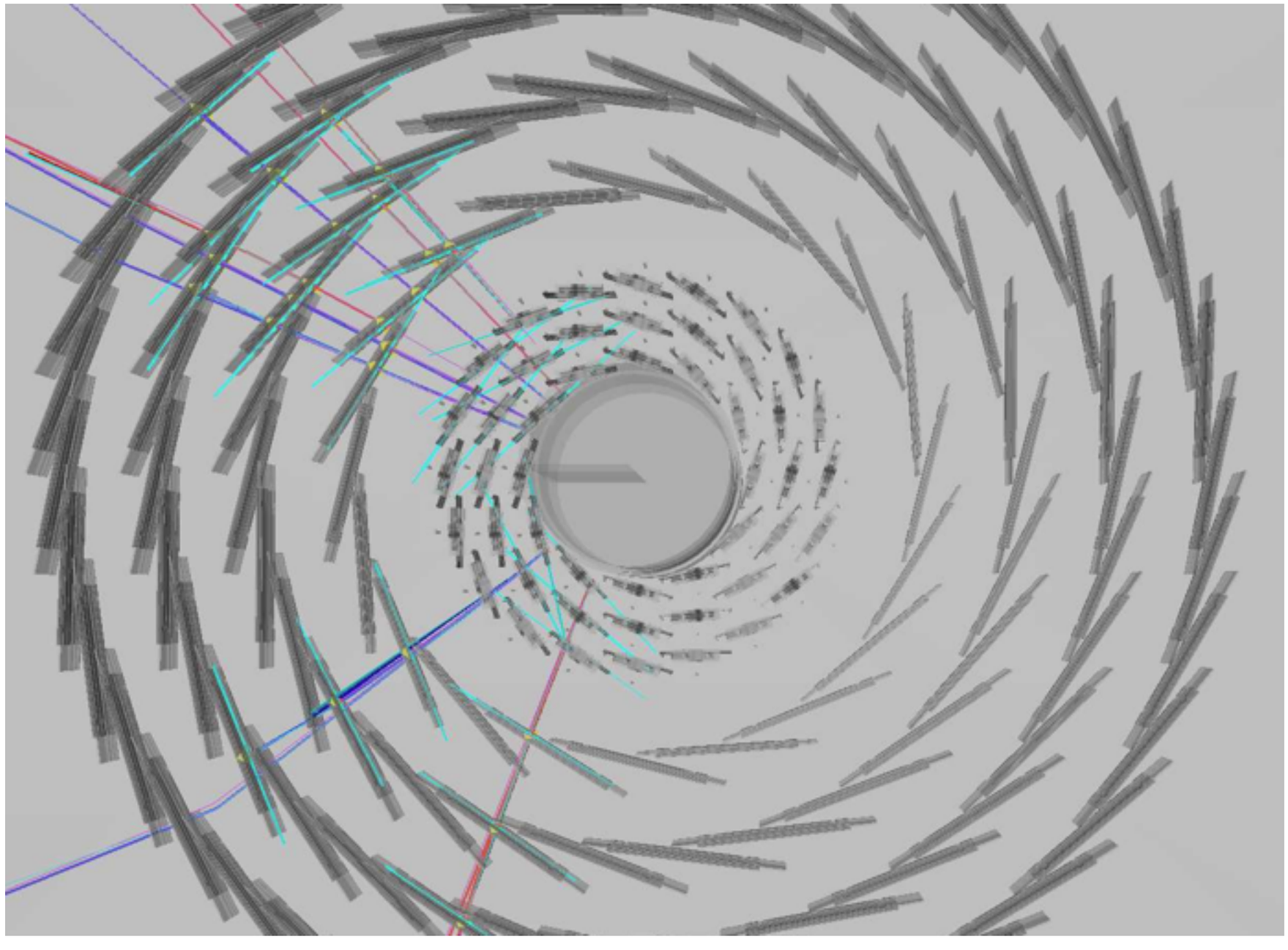
Total thickness
= 9.0%





Does this make sense?

Yes. The INTT ladders are ~ 1% thick, but their overlap in azimuthal angle is ~ 100%. This is necessary to produce a 25% overlap in sensor coverage.



Effect on Upsilon mass resolution

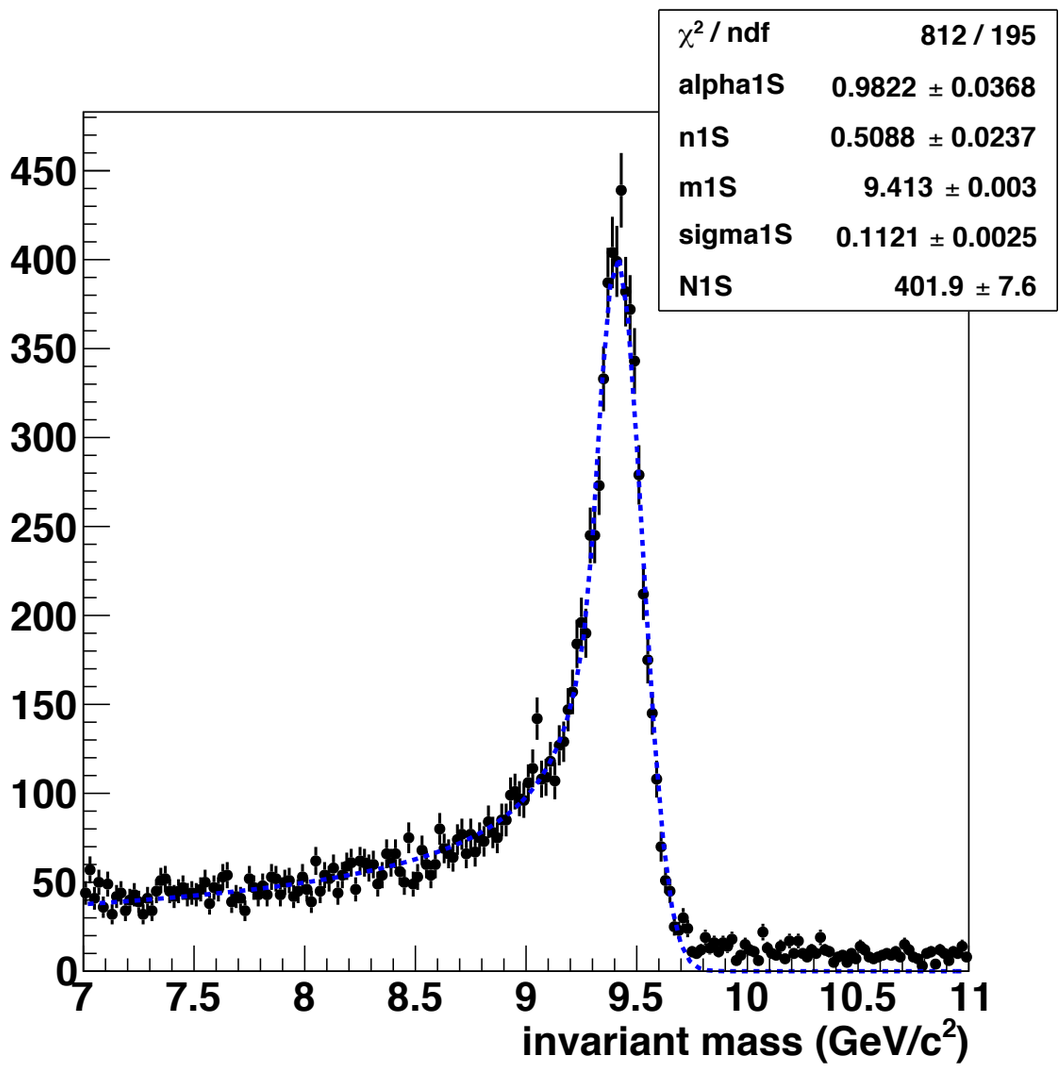
Run with Kalman refitter:

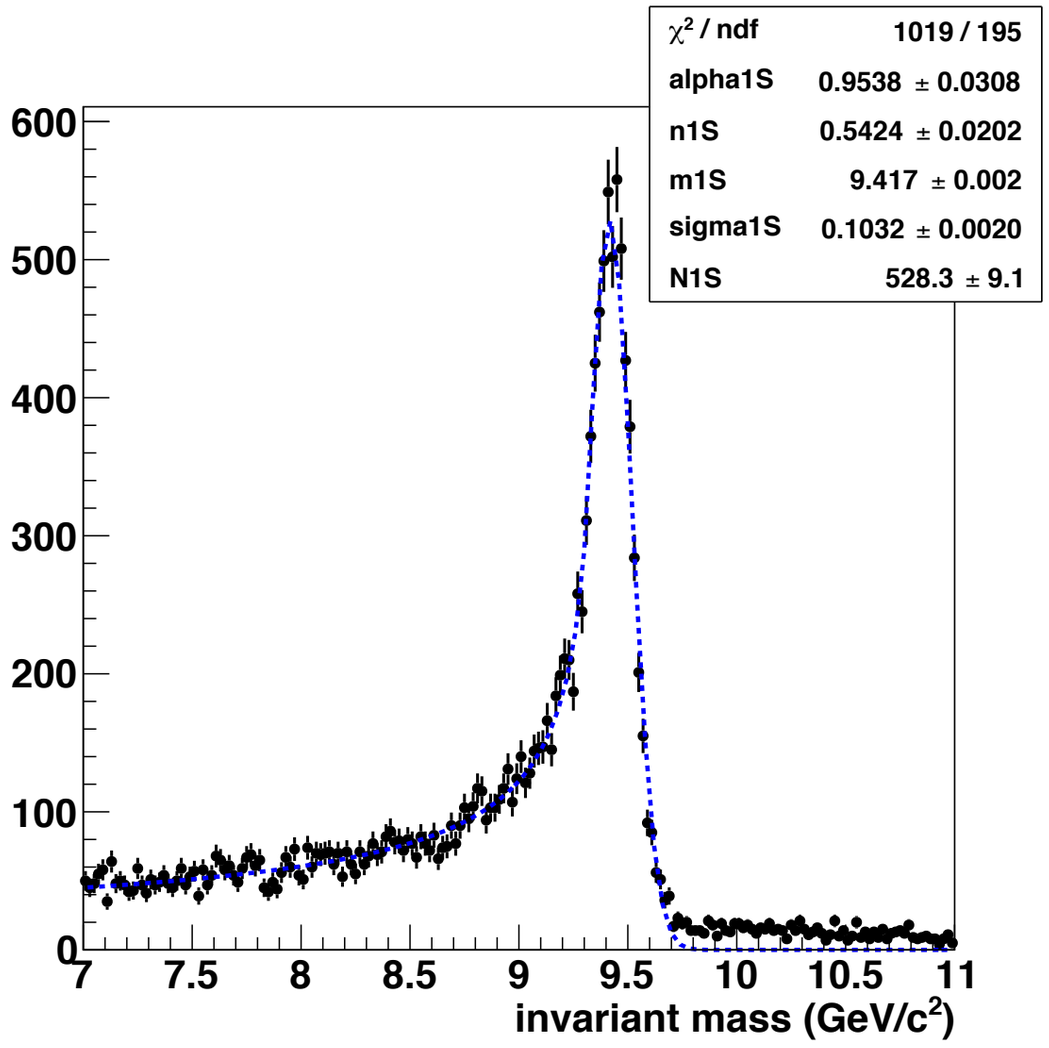
```
PHG4TrackKalmanFitter *kalman = new PHG4TrackKalmanFitter();

  kalman->set_detector_type(PHG4TrackKalmanFitter::LADDER_MAPS_LADDER_IT_TPC);
  kalman->set_output_mode(PHG4TrackKalmanFitter::OverwriteOriginalNode);

  se->registerSubsystem(kalman);
```

Upsilon 1S

Ladder MAPS (3 layer) + INTT (4 layer) + TPC (2 tries):

mass resolution
= 103 +/- 2.0 MeV



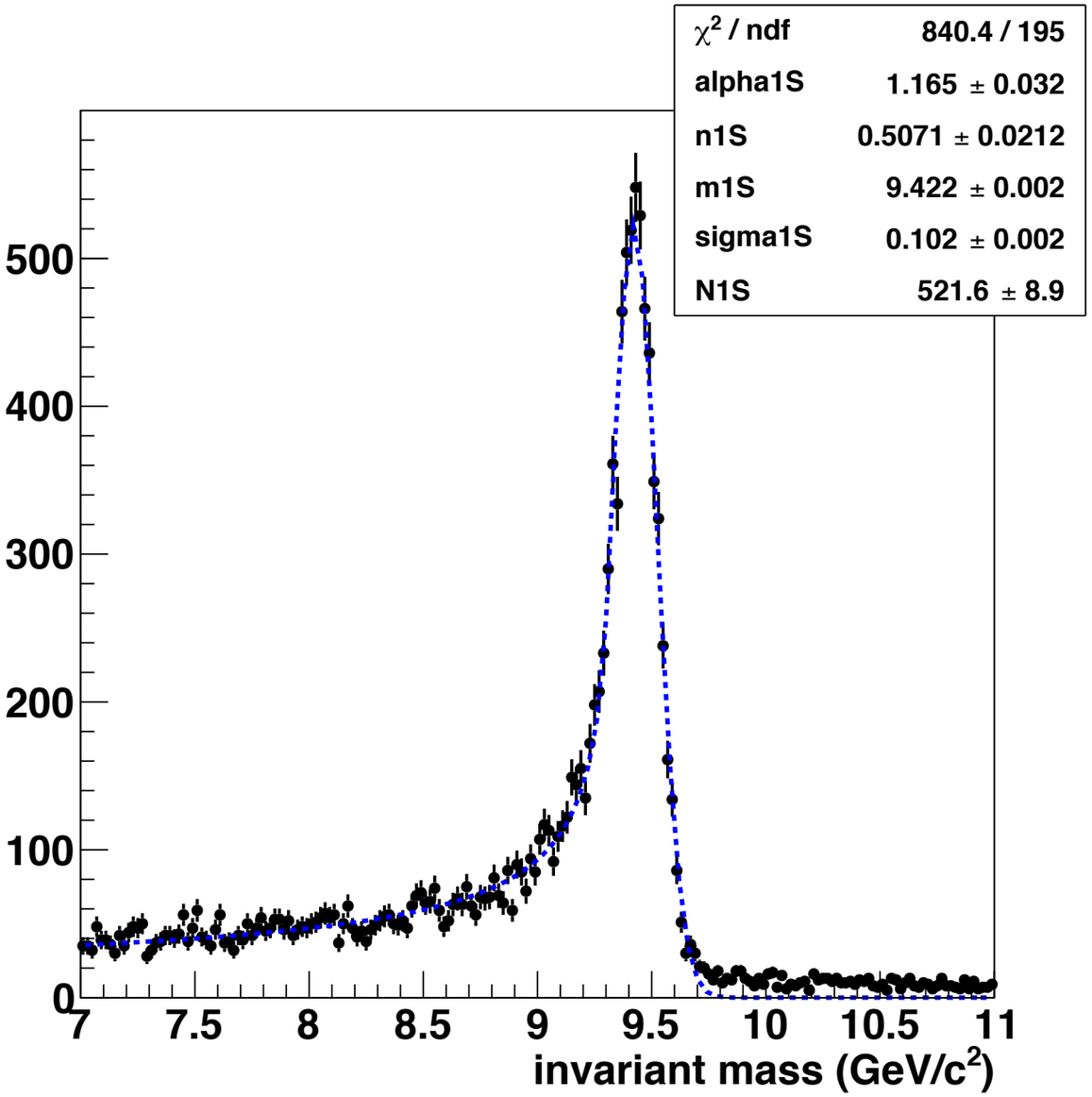


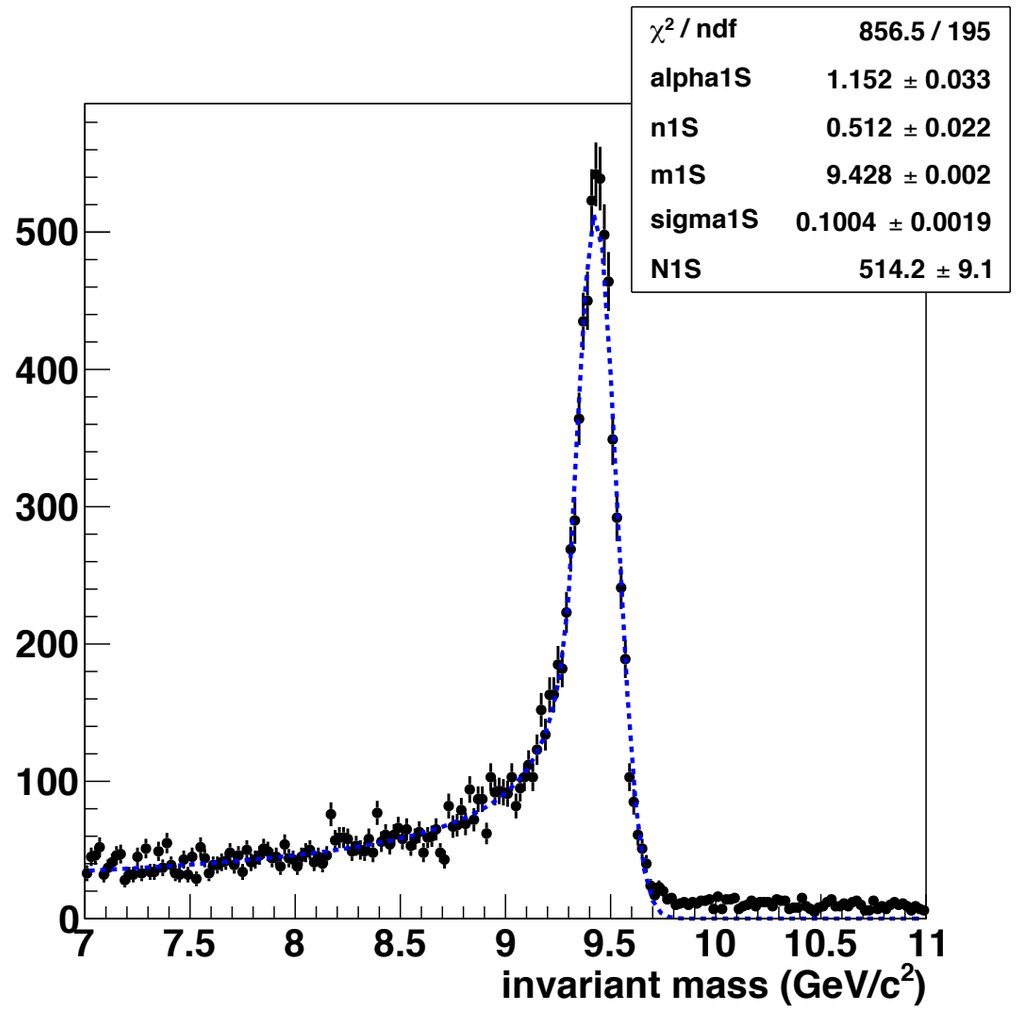
mass resolution
= 112 +/ 2.5 MeV

Upsilon 1S

Ladder MAPS (3 layer) + INTT (3 layer) + TPC (2 tries):

Mass resolution
= 100 +/ 1.9 MeV



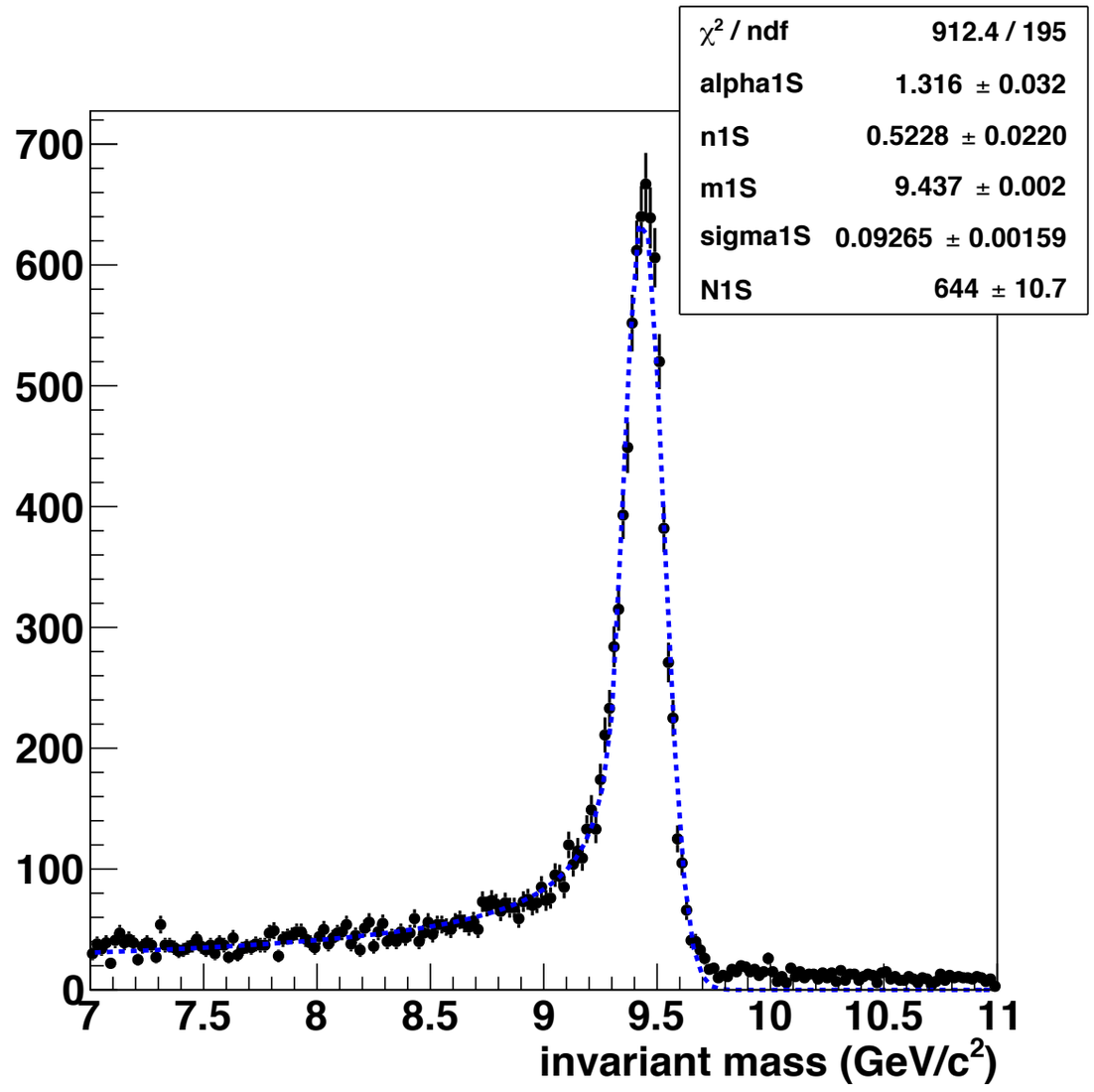


Mass resolution
= 102 +/- 2.0 MeV

Upsilon 1S

Ladder MAPS (3 layer) + INTT (2 layer) + TPC (2 tries):

Mass resolution
= 93 +/- 1.6 MeV



Conclusions

The INTT ladders are approximately twice as thick as we have been assuming (7.4% instead of 4.0% for 4 layers).

This is a big problem for the Upsilon measurement, pushing the mass resolution well above 100 MeV for 4 layers of INTT.

With the present thickness of the INTT layers, I don't see how we can use more than 2 layers.